

XXVII. ON THE GENERIC POSITION OF SOME ASIATIC UNIONIDÆ.

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This paper deals with the anatomy, etc. of Unionids from countries as far apart as the Malay Archipelago and Burma on the one hand and Palestine on the other.

I. ON THE GENUS *MONODONTINA*, Conrad.

In a recent paper,¹ while describing the soft parts of an Indian form of the genus *Pseudodon*, Gould, I questioned the propriety of Simpson's grouping² of the various species of that genus. This observation was based on a study of the soft parts of the species *P. salvenianus*, Gould—the type-species of the genus. I felt myself justified in making the remark referred to, because my description of *P. salvenianus* differed very materially from that of the genus *Pseudodon* as compiled by Simpson (*loc. cit.*) from Deshayes and Jullien's figure of *P. moreleti*.³ It was, however, impossible for me to go into the question in any greater detail as I had no material of the other species. Through the courtesy of Mr. Van der Doop of Sumatra, Dr. N. Annandale recently received a large consignment of molluscs from Sumatra for identification, and he very kindly passed on the entire collection of Unionids to me. This collection, though consisting of a single form, has proved very valuable in enabling me to clear up a number of doubtful points regarding the synonymy of some of the species; as also of the various groups assigned by Simpson to the genus *Pseudodon*. According to that author, the species to which the specimens must be assigned is *P. chaperi* (de Morgan). The question of the validity of this species is, however, discussed at length further on.

To understand properly the situation regarding the generic name of the group to which the species under consideration belongs, it is necessary to go into the history of the type-species of *Monodontina*, namely *M. vondembuschiana* (Lea). This species was originally described by Lea as *Margaritana vondembuschiana*,⁴ though in a later work⁵ he changed the name to *Margaron* (*Mono-*

¹ *Rec. Ind. Mus.*, XVI, pp. 289-297 (1919).

² *Proc. U.S. Nat. Mus.*, XXII, pp. 501-1075 (1900).

³ *Nouv. Arch. du Mus.*, X, pl. v, figs. 1-3 (1874).

⁴ *Proc. Amer. Phil. Soc.*, I, p. 288 (1840). ⁵ Lea, *Synopsis*, p. 45 (1852).

condylea) *vondembuschiana*. H. & A. Adams,¹ recognizing the validity of d'Orbigny's genus *Monocondylea*, assigned the species to that genus. Later Conrad² established a new genus *Monodontina* for the same species,³ abbreviating the specific name also; but subsequently, considering his new genus to be a synonym of Gould's *Pseudodon*, he again described the species as *P. vondembuschiana*. Simpson (*loc. cit.*), following Conrad, has included the form in the genus *Pseudodon*, making it however the type of a distinct group, which included a number of other species. This grouping on the whole is artificial, since widely different species such as *P. salvenianus* have been included in the group of *P. vondembuschiana*. A few other unimportant changes affecting the name of this species are given by Simpson.

The material from Sumatra has made it possible for me to examine the animal of a form of *P. vondembuschiana*, and as a result of this examination I have found it necessary to revive Conrad's genus *Monodontina*—because the animal of the Sumatran species—a form of the type-species of *Monodontina*—is very different from that of the type-species of *Pseudodon*, namely *P. salvenianus*. I have also added a few notes on the synonymy of the other species, based on an examination of the collection of the Zoological Survey of India (Indian Museum) and a critical study of the excellent figures in Haas' incomplete monograph⁴ and other available literature.

Of the species included by Simpson in this group *P. ellipticum*, *P. zollingeri*, *P. cumingii*, *P. aeneolus* and *P. tumidus* seem to be related to *M. vondembuschiana*, and will probably have to be assigned to Conrad's genus *Monodontina*. It is, however, impossible for me to go further into this question as no specimens of these forms are available. It is also impossible to express any opinion as to *P. thomsoni*, *P. cambodjensis* and *P. nicobaricus* owing to incomplete information, while *P. moreleti* cannot be included in the genus, for, as is shown in the rather poor figure of the soft parts by Deshayes and Julien (*loc. cit.*), the animal appears to be very different from that of *M. vondembuschiana*. Specimens of *P. inoscularis* identified as such by Mr. H. B. Preston, and now in the collection of the Zoological Survey of India, are undoubtedly no more than a variety of *M. vondembuschiana*, while specimens of *P. chaperi* also merge very gradually into this species. *P. zollingeri*, as stated above, is undoubtedly a distinct species, but I do not think that Mousson⁵ was right in including in it shells which he described as var. *angulosa*, for this latter is probably nothing more than what I describe below as var. *chaperi*

¹ *Gen. Rec. Moll.*, p. 561 (1858).

² *Proc. Acad. Nat. Sci. Philadelphia*, VI, pp. 266-449 (1853).

³ *Amer. Journ. Conchology*, I, p. 233 (1865).

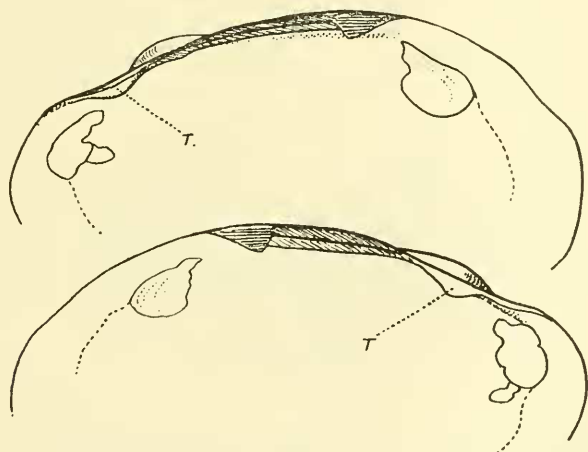
⁴ Martini und Chemnitz, *Conch. Cab.* (ed. Kuster), *Unio*. Owing to the war no further instalments of this work were received in the Calcutta libraries after page 256 and plate 59 (1910).

⁵ *Moll. Java*, Zurich, p. 96, pl. xvii (1849).

of *M. vondembuschiana*. Simpson considers Mousson's species *Alasimodonta crispata* synonymous with *M. vondembuschiana*, but in my opinion it is a distinct species, as it was also considered to be by von Martens.¹

Monodontina, Conrad.

As already stated, the genus was established by Conrad for Lea's species *Margaritana vondembuschiana*, with the following description: "Hinge with an obtuse rounded tooth immediately below the beak." It may be redescribed as follows:—Shell rather thin, rhomboid ovate, rounded in front, truncated posteriorly, with the result that the posterior margin is nearly straight; with a narrow wing and a feebly developed posterior ridge; in young specimens a second ridge also visible above the posterior ridge;



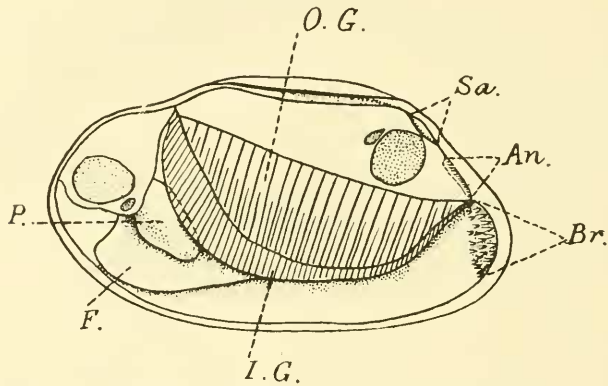
TEXT-FIG. 1.—*Monodontina vondembuschiana*, var. *chaperi*, hinge and muscle-scars.

umbo compressed, beak sculpture consisting of concentric zig-zag lines; shell practically smooth except for lines of growth; hinge-line straight (fig. 1); a single smooth cardinal tooth (T) in each valve, that of the right valve situated just in front of the umbo and fitting in front of that of the left valve; lateral tooth represented by a feebly developed ridge in each valve, its posterior limit having a triangular brownish scar containing a prolongation of the hinge-ligament; the two anterior muscle-scars prominent, uniting with one another and having very irregular outlines; posterior muscle-scars very faint and separate; nacre bluish, somewhat iridescent with a brownish marginal line running parallel to the border at a little distance from the edge.

The animal of the Sumatran form (fig. 2) has the inner pair of gills very much wider than the outer throughout their entire length.

¹ *Malakol. Blätter*, XIV, p. 13 (1867).

The inner lamellae of the inner pair of gills are attached to the abdominal sac only along one-third of their anterior length, while the posterior two-thirds is quite free until the lamellae of the opposite sides meet each other a little behind the posterior margin of the abdominal sac and unite to form the diaphragm. The outer lamellae of the outer pair of gills are united with the mantle all along. The diaphragm is complete and is formed only by the gills, there being no mantle connection between the branchial and the anal apertures, though the mantle-wall of the opposite sides is slightly drawn in. The palpi are well developed, rather ellipsoid in outline, with a narrow base of attachment to the abdominal mass and further attached along one half of their posterior margin to the mantle. The anterior margin of the gills is separated from the palps by a small gap. The branchial aperture is large with two to three rows of elongated papillae; the anal is a little more



TEXT-FIG. 2.—Animal of *M. vondembuschiana*, var. *chaperi*. An.=anal aperture; Br.=branchial aperture; F.=foot; I.G.=inner gill; O.G. outer gill; P. palp; Sa. supra-anal.

than two-thirds the size of the branchial and is quite smooth; the supra-anal is much smaller than either and is separated from the anal by a small mantle connection. The foot is fairly large.

A comparison of the above description of a form of the genus *Monodontina* with that of *Pseudodon* described in my former paper (*loc. cit.*, p. 295) shows that the two genera differ from each other in the following respects:—

1. The inner lamellae of the inner pair of gills of *Monodontina* are free from the abdominal sac along two-thirds of their length, while in *Pseudodon* they are attached all along.
2. There is a distinct supra-anal in *Monodontina*, but owing to the absence of a mantle connection in the position between the anal and supra-anal of other genera there is no distinction between the anal and the supra-anal in *Pseudodon*.
3. The anal is quite smooth in *Monodontina*, whereas its lower part is papillose in *Pseudodon*.

4. The foot in the genus *Monodontina* is a much better developed structure than in *Pseudodon*.

Relationships.—Frierson¹ in discussing the relationship of *Pseudodon resuspinatus*, von Martens, says that the outline and sculpture are very like that of the genus *Virgus*, while specimens of *Nodularia* (probably *brandtii* from Japan) show a very close kinship to *Pseudodon* in the teeth and general facies. I do not, however, think that the comparison is quite correct for the sculpture of *Virgus* (vide Simpson, *loc. cit.*, p. 852) is quite different from that of any of the species of *Pseudodon* that I have seen, and also from that of the species that I now assign to the genus *Monodontina*. The hinge also is quite different in the two genera. The above remarks apply with equal force to the comparison made by the same author between *Nodularia* (probably *brandtii*) and *Pseudodon*, for the hinge and teeth in the group of *Nodularia japonensis*, to which *N. brandtii* belongs, are very different from those of *Pseudodon* and *Monodontina*. *Monodontina*, on the other hand, seems to have a rather close relationship with the group of *Nodularia contradens*, which Haas (*loc. cit.*, p. 173) has recently separated into a distinct genus *Contradens*.

Monodontina vondembuschiana (Lea).

1900. *Pseudodon vondembuschiana*, Simpson, *op. cit.*, p. 836.

1910. *Pseudodon vondembuschiana*, Haas, *op. cit.*, pl. xlv, figs. 4, 5.

A number of specimens of the typical form are present in the collection of the Zoological Survey, from Sarawak, and one specimen from the Philippine Islands (presented by the late Mr. W. Theobald). Mr. H. B. Preston also identified some shells (No. M⁵⁹²¹) from Pegu as *P. vondembuschiana*, although he does not mention this species in his volume in the 'Fauna of British India.' These last-mentioned specimens, however, do not even belong to the genus *Monodontina*; they are rather specimens of *Pseudodon crebristriatus* and *P. peguensis*.

Var. *chaperi* (de Morgan).

1885. *Pseudodons chaperi*, de Morgan, *Bull. Soc. Zool. France*, X, p. 423, pl. ix, fig. 1.

1900. *Pseudodon chaperi*, Simpson, *Proc. U.S. Nat. Mus.*, XXII, p. 838.

Both de Morgan and Simpson considered this a distinct species. The large number of specimens of different ages received from Sumatra, however, show beyond doubt that it is no more than a variety of *M. vondembuschiana*. *P. zollingeri*, var. *angulosa* of Mousson (*loc. cit.*) also seems to me to be no more than a variety of that species. Indeed, it is probably identical with the var. *chaperi*, but it is impossible to express a definite opinion on this point without further material.

The record of the occurrence of this variety in Sumatra greatly extends its range, for it was previously known from

¹ *Nautilus*, XXIV, p. 97 (1911).

Cambodia and Siam only. It probably occurs also in the Malay Peninsula, the freshwater molluscs of which are little known.

Var. **inoscularis** (Gould).

1844. *Anodon inoscularis*, Gould, *Proc. Boston Nat. Hist. Soc.*, I, p. 160.
 1900. *Pseudodon inoscularis*, Simpson, *Proc. U.S. Nat. Mus.*, XXII, p. 837.

There are two specimens of this form in the collection, one labelled "Tenasserim" and another "Tenasserim river."

It differs from the typical form in the shell being much smaller and more depressed, the posterior wing rather broader, the surface smoother and the cardinal tooth better developed.

Monodontina cumingii (Lea).

1850. *Anodonta cumingii*, Lea, *Proc. Zool. Soc. London*, p. 199.
 1900. *Pseudodon cumingii*, Simpson, *op. cit.*, XXII, p. 837.

A single specimen from Cambodia in the collection belongs to this species.

A point worth noting about *M. cumingii* is that the origin of the cardinal tooth is exactly in line with the upper margin of the shell.

II. SUB-GENERA OF *UNIO* FROM THE NEAR EAST.

The specimens on which this part of the paper is based were collected by Dr. Annandale in 1912 in the Lake of Tiberias.¹ The entire collection of molluscs from this area was reported on by Preston,² but nothing was said by him about the anatomy of the various forms; further, the identifications of the two forms treated of in this paper are not correct in view of later work. One of the species belongs to Germain's recently proposed subgenus *Rhombunio*,³ while I have found it necessary to give a new subgeneric name to the other species. Annandale⁴ also has pointed out the great confusion that exists regarding the nomenclature of the various species of the genus *Unio* from Palestine, but I am unable to go into the question further owing to insufficient material of the related forms. I have, however, adopted Germain's plan of dividing the genus *Unio* into subgenera instead of groups as Simpson⁵ had done, because Germain's idea conduces to a clearer understanding of the relationships.

Rhombunio, Germain.

Germain proposed this subgenus in 1911 (*loc. cit.*) for a group superficially resembling that of *Unio littoralis* group. According

¹ For further details about locality, etc., reference may be made to *Journ. As. Soc. Bengal*, IX, p. 17 onwards (1913).

² *Ibid.*, pp. 465-476, pl. xxvii (1913).

³ *Bull. Mus. D'Hist. Nat. Paris*, XVII, p. 67 (1911).

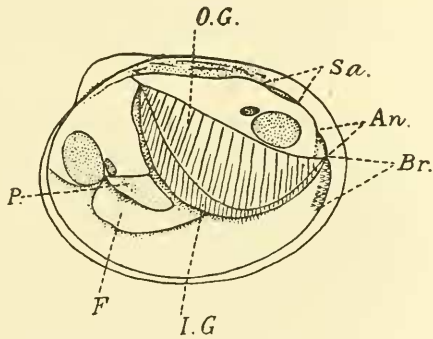
⁴ *Journ. As. Soc. Bengal*, XI, p. 459 (1915).

⁵ *Proc. U.S. Nat. Mus.* XXII, p. 679 onwards (1900).

to him this subgenus differs from *Unio*, s.s. in both shell characters and the soft parts. He stated in his paper that the account of the subgenus would be published later, but so far no such account has appeared.

In Dr. Annandale's collection there are three specimens of *Unio* (*Rhombunio*) *semirugatus* preserved in spirit; these were identified as *Unio simonis* by Preston. One of the three specimens is a gravid female. The following description of the soft parts of the sub-genus is based on this material.

Corresponding to the shape of the shell the gills (fig. 3) are fairly broad but rather short; the inner pair being much broader than the outer, particularly in the anterior half. There is only a very small gap between the anterior margin of the gills and the posterior margin of the palpi. The outer lamellae of the outer pair of the outer gills are attached to the mantle all along their length. The inner lamellae of the inner pair of gills are free from the abdom-

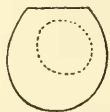


TEXT-FIG. 3.—Animal of *Unio* (*Rhombunio*) *semirugatus*, reference lettering same as in fig. 2.

inal sac except for a very short distance near the extreme anterior end; posteriorly the lamellae of opposite sides unite to form the diaphragm. The diaphragm is formed entirely by the gills, the mantle taking no part in its formation. The outer pair of gills alone are marsupial, but in these also a very small anterior and a much smaller posterior portion of each is not modified for a marsupial function. The margins of the marsupial gills are quite sharp even when the gills are charged with glochidia. The water-tubes in the gills are simple but well developed. The septa in the outer pair of gills are very crowded in the female, but in the male the arrangement is practically the same as in the inner pair of gills. The palpi are ellipsoid, attached to the abdominal sac along their base, and along nearly half of their posterior margin to the mantle. The branchial, anal and supra-anal openings are as is usual; the mantle connection between the anal and the supra-anal being nearly equal in length to the supra-anal and slightly larger than the anal, while the branchial is much larger. The branchial bears

three to four rows of elongated papillae at its edge, while the mantle covering also in this region is crenulate. The anal is smooth and so is the margin of the mantle below the branchial.

The glochidia (fig. 4) are very like those of *Physunio ferrugineus*¹ in outline, but have the hooks much better developed. They measure .23 mm. × .19 mm.



TEXT-FIG. 4.—Glochidium of *Unio* (*Rhombunio*) *semirugatus*, × 75.

The animal of this sub-genus differs from that of *Unio*, s.s., as described by Ortmann,² in having the whole organism of a much more compact type, the gills much

shorter and broader, in the different shape of the palpi, the extent of the marsupial region and the very different shape of the glochidium.

Eolymnium, sub-gen. nov.

This new sub-genus is proposed for the species *Unio terminalis*, Bourguignat, and its allies. A large number of specimens of this species were collected by Dr. Annandale from the Lake of Tiberias in October, 1912.

Simpson (*loc. cit.*, p. 689) includes this species in his group of *Unio pictorum* (Linn.), the type of the section *Lymnium*, and Germain has followed him in calling the species *Unio* (*Lymnium*) *terminalis*. The soft parts of *Unio terminalis*, however, are very different from those of *U. pictorum* as described by Ortmann (*loc. cit.*, pp. 274-275). I have, therefore, found it necessary to separate *U. terminalis* into a distinct sub-genus. Reference here might also be made to the interesting controversy started by Thiele³ regarding the validity of the generic name *Unio*. Haas⁴ took objection to his statement and expressed the opinion that the name *Unio* could not be replaced by *Lymnium*, because Bruguière's name had priority over that of Oken. Ortmann,⁵ who has recently summed up the whole situation very well, has come to the conclusion that *Lymnium* is nothing more than a synonym of *Unio* as restricted by Bruguière.

The animal (fig. 5) of the sub-genus *Eolymnium* may be described as follows:—The gills are elongate but relatively shorter than in *Unio pictorum*. The inner pair of gills is much broader than the outer throughout their length and the free region of the inner lamellae of the inner pair of gills is also much larger than in *U. pictorum*; the other attachments of the gills are similar to those described for *Rhombunio*. The outer pair of gills, except at the extreme anterior end, is marsupial, as was ascertained by cutting sections. The palpi are similar to those of *U. pictorum* except that they are more pointed

¹ *Rec. Ind. Mus.*, XIV, p. 184, pl. xxii, fig. 10 (1918).

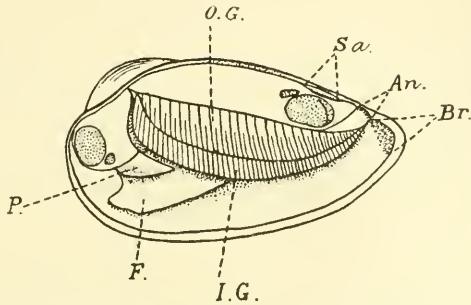
² *Ann. Carnegie Mus.*, VIII, pp. 273-275 (1911-12).

³ *Nachr. Bl. deutsch. Malakozool.*, XLII, p. 29 (1909).

⁴ *Ibid.* pp. 68-72 (1909).

⁵ *Nautilus*, XXV, pp. 88-91 (1911).

at the tip. The branchial aperture occupies nearly the whole of the curved posterior end of the shell and hence the anal is placed higher above; it is separated from the anal by a distinct notch and has three rows of elongated papillae on its margin. The anal is about half the size of the branchial and is smooth; it is separated from the supra-anal by a mantle connection a little more than half



TEXT-FIG. 5.—Animal of *Unio (Eolymnium) terminalis*, reference lettering same as in fig. 2.

the size of the anal and very much smaller than the supra-anal. The foot is rather poorly developed.

The glochidia are unknown, as none of the specimens are gravid.

This sub-genus comes near the group of *U. pictorum*, but differs in the general shape of the animal, the shape and size of the gills, the relations of the branchial, anal and supra-anal apertures, and in the poorer development of the foot.

